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| 09/462,796 | 01/13/2000 | TAKAYOSHI WATANABE | 500.38090X00 | 5528 |

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| EXAMINER |
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NGUYEN, THANH T

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| ART UNIT | PAPER NUMBER |
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2813

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05/17/2007

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

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| Office Action Summary | Application No. 09/462,796 | Applicant(s) WATANABE ET AL. | |
| | Examiner Thanh T. Nguyen | Art Unit 2813 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
 - If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
 - If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
 - Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 17 April 2007.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 34-62 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 34-62 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Request for Continued Examination

The request filed on 3/2/07 for a Request for Continued Examination (RCE) under 37 CFR 1.114 is acceptable and an RCE has been established. An action on the RCE follows.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 34-36, 38, 42, 44, 54-61 are rejected under 35 U.S.C. 102(e) as being anticipated by Wark et al. (U.S. Patent Publication No. 2001/0054771).

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Referring to figures 1-12, Wark et al. teaches a method of producing a semiconductor device comprising the steps of:

Forming a plurality of pyramid-shaped bump electrodes (24/42/48/132/510) to the pad electrode (22/26/508); and

Connecting the pyramid-shaped bump electrodes (24/42/48/132/510) to the pad electrode (22/26/508) of the semiconductor device:

Wherein the step of forming the plurality of pyramid-shaped bump electrodes (24/42/48/132/510) including:

A step of forming pyramid-shaped etched holes by anisotropically etching a base material having a crystal orientation ((see paragraph# 52), and

A step of filling up the etched pyramid-shaped holes by plating a metal (see paragraph# 19) to form the pyramid-shaped bump electrodes, wherein the shape of the pyramid-shaped bump electrode is identical to a shape of the etched pyramid-shaped holes (see paragraph# 59); and

Wherein the step of connecting the pyramid-shaped bump electrodes (24/42/48/132/510) to the pad electrodes (22/26/508) includes:

A step of attaching the base of the pyramid-shaped bump electrodes (24/42/48/132/510) to the pad electrodes (22/26/508, see figures 1b, 2b, 3b, 4b, 5b, 6b, 7b, 12), and

A step of transferring the pyramid-shaped bump electrodes (24/42/48/132/510) to the pad electrodes (22/26/508, transferring process is the same as attaching based on the instant invention);

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Wherein the pyramid-shaped bump electrodes (24/42/132/48/510) are each formed by a conductive material (see paragraph# 43, 52, 59), and

Wherein the pyramid-shaped bump electrodes (24/42/132/48/510) have a shape of a pyramid, which is a figure having a square base and four triangle shaped sides (see figure 2a-2b, 7a-7b, see paragraph# 46, 49, 54, it is noted that figures 2a-2b, pyramid (40) is formed of 4 smaller pyramids make from 46, 48, 50).

Regarding to claim 35, wherein the step of forming etched holes and the step of filling up the etched holes, further includes a step of forming a primary film of the same material as the metal for the plating of the metal on the base material having a crystal orientation and on a side surface of each of the etched holes, thereby filling the etched holes by plating metal by using the primary film (noted that since the projection can be formed more than one layers, see paragraph# 43; hence, the first layer is the primary layer, and the second layer form the pyramid-shaped bump electrode, see paragraph# 52, 59).

Regarding to claim 36, before the step of forming the etched holes, further includes a step of forming a first pattern having opening portions at positions corresponding to the etched holes by etching a first oxidized film formed on the base material having the crystal orientation (see paragraph# 52, 56), a step of forming the etched holes by using the first pattern as a mask (Si_3N_4 , see paragraph# 52).

Regarding to claims 38, 39, forming a gold plated film on the metal plated film (see paragraph# 43).

Regarding to claims 42-43, forming a gold plated film on the metal plated film (see paragraph# 43).

Regarding to claims 44-45, after the step of connecting the pyramid-shaped bump electrodes to pad electrodes of the semiconductor device, further includes a step of forming a gold plated film on the surface of the pyramid-shaped bump electrodes (see paragraph# 43).

Regarding to claim 54, the plurality of pyramid-shaped bump electrodes is separated from one another at least after the step of the connecting the pyramid-shaped bump electrode to the pad electrode of the semiconductor device (see figure 8a-10).

Regarding to claim 55, removing the base material from the pyramid-shaped bump electrode after the step of connecting the pyramid-shaped bump electrodes to pad electrodes of the semiconductor device (see figure 10b-10d, 12)

Regarding to claim 56, the pyramid-shaped bump electrodes keep its pyramid-shaped shape after the step of connecting the pad electrode (see figure 1b, 2b, 3b, 4b, 5b, 67, 7b).

Regarding to claim 57, each tip of the pyramid-shaped bump electrodes is bonded to a terminal formed on a substrate after the step of connecting the pyramid-shaped bump electrodes to pad electrodes of the semiconductor device (see figure 12).

Regarding to claim 58, each tip of the pyramid-shaped bump electrodes is thermally compressed to terminal formed on the substrate (see paragraph# 60).

Regarding to claim 59, each tip of the pyramid-shaped bump electrodes is soldered to the terminal formed on the substrate (see figure 12).

Regarding to claim 60, the terminal is provided on a wiring conductor (508, see figure 12).

Regarding to claim 61, a method of producing a semiconductor device comprising the steps of:

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Forming a plurality of pyramidal bump electrodes (24/42/48/132/510) of the semiconductor device; and

Wherein the pyramidal bump electrodes (24/42/48/132/510) have shape of a figure comprising a rectangular base and at least two triangle-shaped sides (see figure 5a).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 37, 39-41, 43, 45-53, 62 are stand rejected under 35 U.S.C. 103(a) as being unpatentable over Wark et al. (U.S. Patent Publication No. 2001/0054771) as applied to claims 34-36, 38, 42, 44, 54-61 above, in view of Ochiai et al. (U.S. Patent No. 5,643,831).

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Referring to figures 1-12, Wark et al. teaches a method of producing a semiconductor device comprising the steps of:

Forming a plurality of pyramid-shaped bump electrodes (24/42/48/510) to the pad electrode (22/26/508); and

Connecting the pyramid-shaped bump electrodes (24/42/48/510) to the pad electrode (22/26/508) of the semiconductor device:

The step of forming the plurality of pyramid-shaped bump electrodes (24/42/48/510) including:

A step of forming pyramid-shaped etched holes by anisotropically etching a base material having a crystal orientation ((see paragraph# 52), and

A step of filling up the etched pyramid-shaped holes by plating a metal (see paragraph# 19) to form the pyramid-shaped bump electrodes, wherein the shape of the pyramid-shaped bump electrode is identical to a shape of the etched pyramid-shaped holes (see paragraph# 59).

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Wherein the step of connecting the pyramid-shaped bump electrodes (24/42/48/510) to the pad electrodes (22/26/508) includes:

A step of attaching the base of the pyramid-shaped bump electrodes (24/42/48/510) to the pad electrodes (22/26/508, see figures 1b, 2b, 3b, 4b, 5b, 6b, 7b, 12), and

A step of attaching the base of the pyramid-shaped bump electrodes (24/42/48/510) to the pad electrodes (22/26/508, see figures 1b, 2b, 3b, 4b, 5b, 6b, 7b, 12), and

Transferring the pyramid-shaped bump electrodes (24/42/48/510) to the pad electrodes (22/26/508, transferring process is the same as attaching based on the instant invention).

Regarding to claims 39, forming a gold plated film on the metal plated film (see paragraph# 43).

Regarding to claims 43, forming a gold plated film on the metal plated film (see paragraph# 43).

Regarding to claims 45, after the step of connecting the pyramid-shaped bump electrodes to pad electrodes of the semiconductor device, further includes a step of forming a gold plated film on the surface of the pyramid-shaped bump electrodes (see paragraph# 43).

Regarding to claim 62, a method of producing a semiconductor device comprising the steps of:

Forming a plurality of pyramidal bump electrodes (24/42/48/132/510) of the semiconductor device; and

Wherein the pyramidal bump electrodes (24/42/48/132/510) have shape of a figure comprising a rectangular base and at least two triangle-shaped sides (see figure 5a).

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However, the reference does not teach etching a first oxidized film on the base material, removing the first oxidized film and forming a second oxidized film on the etched holes, and filling the metal such as nickel, chromium.

Ochiai et al. teaches a method of etching a first oxidized film on the base material, removing the first oxidized film and forming a second oxidized film on the etched holes (see figures 8A-8H and related text).

Therefore, it would have been obvious to a person of ordinary skill in the requisite art at the time of the invention was made would etch a first oxidized film on the base material, removing the first oxidized film and forming a second oxidized film on the etched holes in process of Wark et al. as taught by Ochiai et al. because the process would bring the plate into a chemically stable condition and provides a low wettability to the plate, so a durability of the plate is improve and formed solder balls can be easily transferred.

It is known in the art to form the filling metal such as nickel, chromium.

Therefore, it would have been obvious to a person of ordinary skill in the requisite art at the time of the invention was made would form the filling metal such as nickel, chromium in process of Wark et al. because process is known in the art since determining the optimum material for the layer only involved routine skill in the art.

Response to Arguments

Applicant's arguments filed 4/17/07 have been fully considered but they are not persuasive.

Applicant contends that Wark fails to teach or suggest the pyramid-shaped bump electrodes have a shape of a pyramid, which is a figure having a square base and four triangle-shaped sides. In response to applicant that Wark clearly teach the pyramid-shaped bump electrodes have a shape of a pyramid, which is a figure having a square base and four triangle-shaped sides (see figure 2a-2b, 7a-7b, see paragraph# 46, 49, 54). It is also noted that Merriam Webster's Collegiate dictionary defined that a pyramid is typically a square ground plan, outside walls in the forms of four triangles that meet in a point at the top, and inner sepulchral chambers; or a structure or object have similar form.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanh Nguyen whose telephone number is (571) 272-1695, or by Email via address Thanh.Nguyen@uspto.gov. The examiner can normally be reached on Monday-Thursday from 6:00AM to 3:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr., can be reached on (571) 272-1702. The fax phone number for this Group is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR

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system, see <http://pairedirect.uspto.gov>. Should you have questions on access to thy Private PAIR system, contact the Electronic Business center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, appearing to read 'Thanh', with a long horizontal stroke extending to the left.

Thanh Nguyen
Patent Examiner
Patent Examining Group 2800